Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Reference Rainfall Data Product IFloodS

Introduction

The GPM Ground Validation Reference Rainfall Data Product IFloodS dataset contains hourly rainfall accumulation estimates over central and northeastern Iowa for the period of 1 May to 16 June, 2013. This product is created by combining ground-based radar estimates collected for the Iowa Flood Studies (IFloodS) campaign. The goals of the IFloodS campaign were to collect detailed measurements of precipitation at the Earth's surface using ground instruments and advanced weather radars and to simultaneously collect data from satellites passing overhead. The data are available in gzipped ASCII files.

Citation

Krajewski, Witold and Bong Chul Seo. 2018. GPM Ground Validation Reference Rainfall Data Product IFloodS[indicate subset used]. Dataset available online from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/GPMGV/IFLOODS/MULTIPLE/DATA301

Keywords:

NASA, GHRC, GPM, IFloodS, radar, Iowa, radar-rainfall, precipitation

Campaign

The Global Precipitation Measurement (GPM) mission Ground Validation campaign used a variety of methods for validation of GPM satellite constellation measurements prior to and after launch of the GPM Core Satellite, which launched on February 27, 2014. The instrument validation effort included numerous GPM-specific and joint agency/international external field campaigns, using state of the art cloud and precipitation observational infrastructure (polarimetric radars, profilers, rain gauges, and disdrometers). Surface rainfall was measured by very dense rain gauge and disdrometer networks at various field campaign sites. These field campaigns accounted for the majority

of the effort and resources expended by GPM GV. More information about the GPM mission is available at https://pmm.nasa.gov/GPM/.

The Iowa Flood Studies (IFloodS) campaign was a ground measurement campaign that took place in eastern Iowa from May 1 to June 15, 2013. The goals of the campaign were to collect detailed measurements of precipitation at the Earth's surface using ground instruments and advanced weather radars and to simultaneously collect data from satellites passing overhead. The ground instruments characterize precipitation – the size and shape of raindrops, the physics of ice and liquid particles throughout the cloud and below as it falls, temperature, air moisture, and distribution of different size droplets – to improve rainfall estimates from the satellites, and in particular the algorithms that interpret raw data for the GPM mission's Core Observatory satellite, which launched in 2014. More information about IFloodS is available at http://dx.doi.org/10.5067/GPMGV/IFLOODS/DATA101. Additional information about the Iowa Flood Center is available at http://iowafloodcenter.org/.

Instrument/algorithm

This reference rainfall data product was generated through the hydro-NEXRAD-2 (HNX2) software system, by combining data from four radars of the Next Generation Radar (NEXRAD) national network in the United States. More details about the hydro-NEXRAD software system and its radar-rainfall estimation algorithms are described in Seo et al. (2010) and Krajewski et al. (2012).

The NEXRAD weather radar makes conventional reflectivity observations and also uses the "Doppler effect" to measure motion of clear air and atmospheric phenomena within storms. The radar data acquisition (RDA) algorithm component derives the parameters reflectivity, radial velocity, Doppler spectrum width, differential reflectivity, copolar correlation, and differential phase . The maximum measurement range of NEXRAD is 230 km. The range resolution is 1 km for reflectivity and 0.25 km for velocity and spectrum width. The azimuthal resolution is 1 degree for reflectivity, velocity and spectrum width. NEXRAD weather radar data from the following four sites are used for this product:

KARX - La Crosse, Wisconsin
LATITUDE: 43.823, LONGITUDE: -91.191
Bounding Box Coordinates:
N: 47.96, S: 39.686111, E: 85.466389, W: 96.915833

KDMX - Des Moines, Iowa
LATITUDE: 41.731, LONGITUDE: -93.723
Bounding Box Coordinates:
N: 45.867778, S: 37.594167, E: 88.187222, W: 99.258611

KDVN - Davenport, Iowa
LATITUDE: 41.612, LONGITUDE: -90.581

Bounding Box Coordinates:
N: 45.748889, S: 37.475, E: 85.055556, W: 96.106667

KMPX - Minneapolis, Minnesota
LATITUDE: 44.849, LONGITUDE: -93.566
Bounding Box Coordinates:
N: 48.985833, S: 40.712222, E: 87.740833, W: 99.391111

This reference rainfall data product also contains data from the portable NASA S-band Dual-Polarimetric (NPOL) radar operated during the IFloods campaign. The NPOL radar is NASA's primary portable weather radar. It has a wavelength of 10.65 cm, an operating frequency of 2700-2900 MHz, variable PRF of 500 and 1000 Hz with a 0.95 degree beam width. NPOL can operate with both horizontal and vertical polarization in both simultaneous and alternating modes. The radar has a prime-focus parabolic reflector which is 8.5 m in diameter and is housed on five seatainers. The NPOL data for IFloodS are available from GHRC (doi: http://dx.doi.org/10.5067/GPMGV/IFLOODS/NPOL/DATA102).

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Data Characteristics

The GPM Ground Validation Reference Rainfall Data Product IFloodS dataset contains gzipped ASCII data files at a Level 4 processing level. More information about the NASA data processing levels are available on the NASA Data Processing Levels website. Table 1 lists the characteristics of this dataset.

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground stations; mobile and fixed
Instrument	Next Generation Weather Radar (NEXRAD); NASA S-band Dual-Polarimetric (NPOL) radar
Spatial Coverage	N: 44.213 , S: 40.729, E: -89.900, W: -94.463 (central and northeastern Iowa)
Spatial Resolution	0.004167 decimal degrees (~.46 km)
Temporal Coverage	May 1, 2013 - June 16, 2013
Temporal Resolution	Hourly
Sampling Frequency	Radar data sampled at 4-5 min intervals, combined to 1 hour

	product
Parameter	precipitation
Version	1
Processing Level	4

File Naming Convention

The GPM Ground Validation Reference Rainfall Data Product IFloodS dataset consists of gzipped ASCII data files with the following file naming convention:

Data files: IFloodS_RefMap_R6004_G_YYYYMMDD_hh0000.asc.gz

Table 2: File naming convention variables

Variable	Description
R60	Hourly rainfall accumulation
04	The number of NEXRAD radars used (KDMX, KDVN, KARX, and KMPX) *the NPOL radar was also used, but did not get included in this number
G	Geographic coordinates used
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
hh	Two-digit hour in UTC
.asc	ASCII format
.gz	Gzipped data files

Data Format and Parameters

The GPM Ground Validation Reference Rainfall Data Product IFloodS dataset consists of gzipped ASCII data files. Each ASCII file has 847 rows. The first 11 rows are header lines as shown below:

```
# file name: IFloodSRef_R6004_G_09MAY2013_000000.out
# Accumulation map [mm]
# Accumulation time [sec]: 3600
# number of columns: 1095
# number of rows: 836
# grid: LATLON
# upper-left LATLONcorner(x,y): 7570 5331
# xllcorner [lon]: -94.462502
# yllcorner [lat]: 40.729168
# cellsize [dec deg]: 0.004167
# no data value: -99.0
```

The upper-left designation listed in the header is grid cell location of the larger, original model system product from which this IFloods Subgrid has been cut from.

Following the header lines are the rainfall accumulation data (rainfall units are mm) arranged in a matrix of 836 rows and 1095 columns. These grid data values correspond to a grid system of 1095 longitudes by 836 latitudes. The first value in the first row corresponds to the upper-left corner of the grid. The lower-left corner of the grid system is at -94.462502 degrees in longitude and 40.729168 degrees in latitude. The size of each grid cell is 0.004167 decimal degrees for both longitude and latitude. The accumulation time (units: second) is given in the header. Missing grid cell data are flagged as -99.0.

Quality Assessment

A significant potential source of error existing in radar-rainfall maps comes from different radar calibration offsets that create a border within discontinuous rainfall fields at the equidistance zone among radars. The discontinuity in rainfall fields can lead to misestimation of rainfall over basins and subsequently, to significant errors in streamflow predictions through a hydrologic model. Seo et al. (2013) produced enhanced radar-rainfall estimates (HN3) based on a novel approach that reduces the effects of the relative radar calibration bias. Seo et al. (2013) present comparisons of this product to other and identify that uncertainties in the rainfall field strongly affect hydrological predictions.

Software

No special software is needed to view the GPM Ground Validation Reference Rainfall Data Product IFloodS ASCII files.

Known Issues or Missing Data

There are no known issues with these data or any known gaps in the dataset.

References

Seo, B., L. K. Cunha, and W. F. Krajewski, 2013: Uncertainty in radar-rainfall composite and its impact on hydrologic prediction for the eastern Iowa flood of 2008. Water Resour. Res., 49, 5, 2747-2764. doi: 10.1002/wrcr.20244

Krajewski, W. F., A. Kruger, S. Singh, B. Seo, and J. A. Smith, 2012: Hydro-NEXRAD-2: real-time access to customized radar-rainfall for hydrologic applications. J. Hydroinf., 15, 2, 580-590. Doi: 10.2166/hydro.2012.227

Seo, Bong-Chul, W. F. Krajewski, A. Kruger, P. Domaszczynski, J. A. Smith, and M. Steiner, 2010: Radar-rainfall estimation algorithms of Hydro-NEXRAD. J. Hydroinf., 13, 2, 277-291. doi: https://doi.org/10.2166/hydro.2010.003

Related Data

All data collected during the IFloodS field campaign should be considered related data sets.

To locate other IFloodS data, use the GHRC search tool HyDRO 2.0 with the search term IFloodS.

The NEXRAD and NPOL data products used to develop this product are available from GHRC:

GPM Ground Validation NASA S-band Dual Polarimetric (NPOL) Doppler Radar IFloodS V2
http://dx.doi.org/10.5067/GPMGV/IFLOODS/NPOL/DATA102

GPM Ground Validation NEXRAD Level II KARX IFloodS
http://dx.doi.org/10.5067/IFLOODS/NEXRAD/DATA201

GPM Ground Validation NEXRAD Level II KDMX IFloodS
http://dx.doi.org/10.5067/IFLOODS/NEXRAD/DATA202

GPM Ground Validation NEXRAD Level II KDVN IFloodS
http://dx.doi.org/10.5067/IFLOODS/NEXRAD/DATA203

GPM Ground Validation NEXRAD Level II KMPX IFloodS
http://dx.doi.org/10.5067/IFLOODS/NEXRAD/DATA204

Contact Information

To order these data or for further information, please contact:

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